Space Weather Technical Forecast

Issued on Wednesday, 11 May 2022 at 01:27 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Slight Chance of G1/Minor Storms on 11 May. Chance of R1-R2 radio blackouts throughout. Slight chance of R3 radio blackouts.

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Solar activity has been High, with an X1.5 at 10/1350UTC from AR3006 (Dai/βγδ) in south-centre disc which may have been produced an Earth-directed CME. This CME will be analysed once sufficient imagery becomes available. AR3007 (Dsi/βγδ) in the southeast quadrant produced a C4.7 flare at 10/1325UTC followed by a CME which has been analysed to not have an Earth directed component. A number of filaments on the visible disc will be monitored for potential eruptions, but no new Earth-directed CMEs have been observed in the last 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind at L1 has been ambient throughout, averaging under 300km/s, with density around average. Total interplanetary magnetic field strength was mainly weak, with a brief spike to 10nT at 10/1257UTC, which may have been due to a CME glancing the Earth's magnetic field. This is supported by a sharp southward deviation in the Bz, to a negative peak of -10nT at 10/1302UTC. Phi angle started positive (away from the Sun) but rotated into a negative orientation at 10/0325UTC. Resultant geomagnetic activity has been Quiet (Kp0-2).

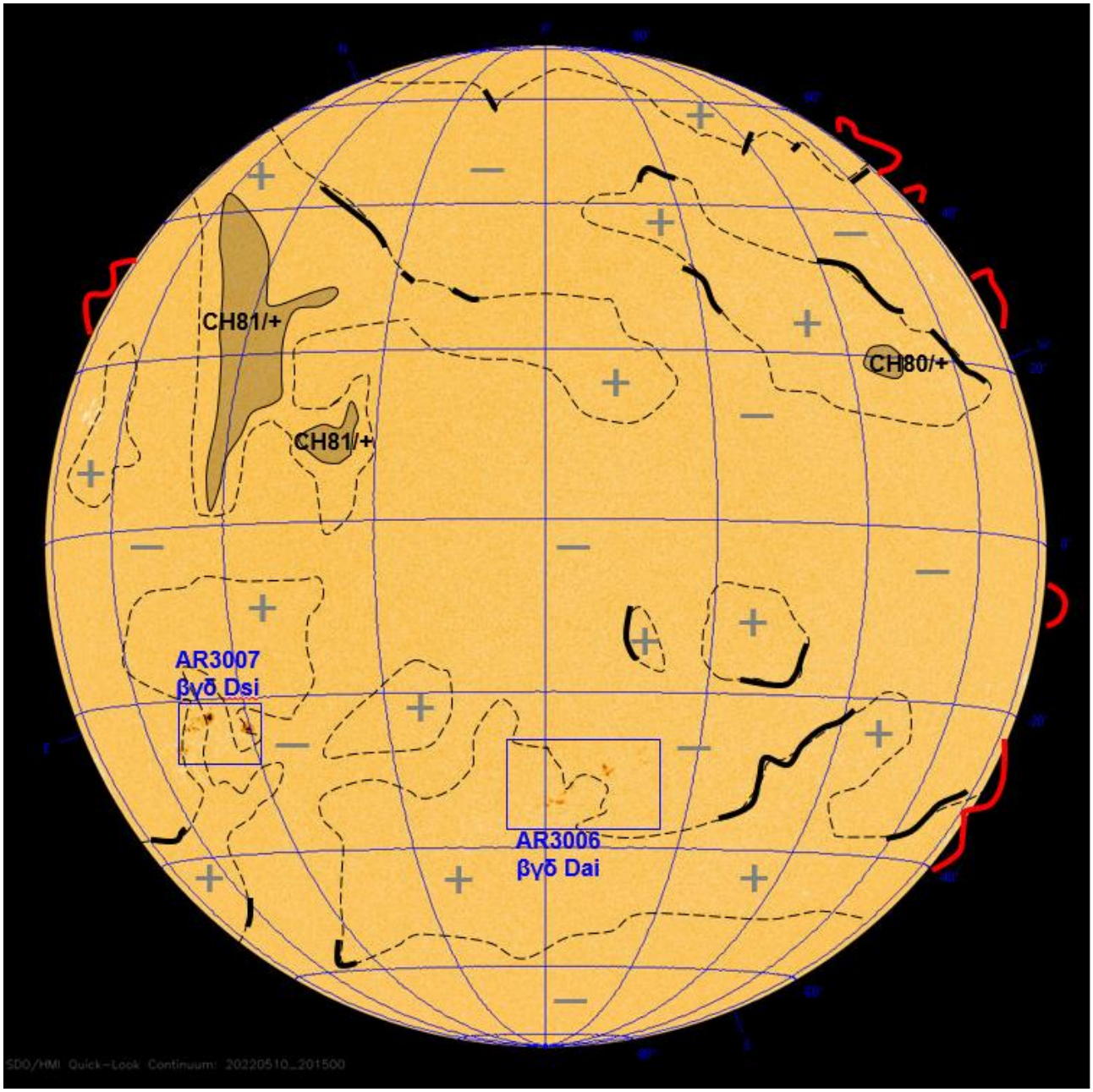
Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) has been at background levels through the last 24 hours. High energy electron flux (greater than 2MeV) has also been at background levels. Electron fluence is below the Active (1e8 integrated pfu) threshold with a mostly flat trend and a value of 1.29e6 integrated pfu observed at 10/2400UTC.

Four-Day Space Weather Forecast Summary
Solar Activity: Solar activity is likely to be mainly Low, but with a Chance of Moderate activity, due to two complex regions on the visible disc. There is also a Slight Chance of High activity, with the main risk from the large complex region in the south-centre disc.

Solar Wind / Geomagnetic Activity: A CME which left the Sun on 06 May was expected to arrive at Earth on 10 May, with a smaller risk of an arrival on 11 May. A coronal hole high speed stream was also due to connect on 10 May, but again with a smaller risk of arrival on 11 May. No further features are expected to affect the Earth through the remainder of the period, but a potential Earth-directed CME which erupted on 10 May which will be analysed once further data becomes available and could arrive at Earth by the end of the period. Geomagnetic activity is expected to be mainly Quiet to Unsettled with a slight chance of G1 storms on 11 May due to any delayed arrival of the CME or high speed stream. A return to mainly Quiet conditions is then likely by the 12 May, although this will need to be reviewed in the light of any potential new CMEs from 10 May.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is expected to start at background levels but with an increasing risk of S1 storms as the two complex regions rotate across into the western hemisphere. The high energy electron flux (greater than 2MeV) is forecast to remain at normal background levels. The 24-hour electron fluence is expected to remain below the Active threshold.

Figure 1. Solar Analysis Valid 10/2000UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

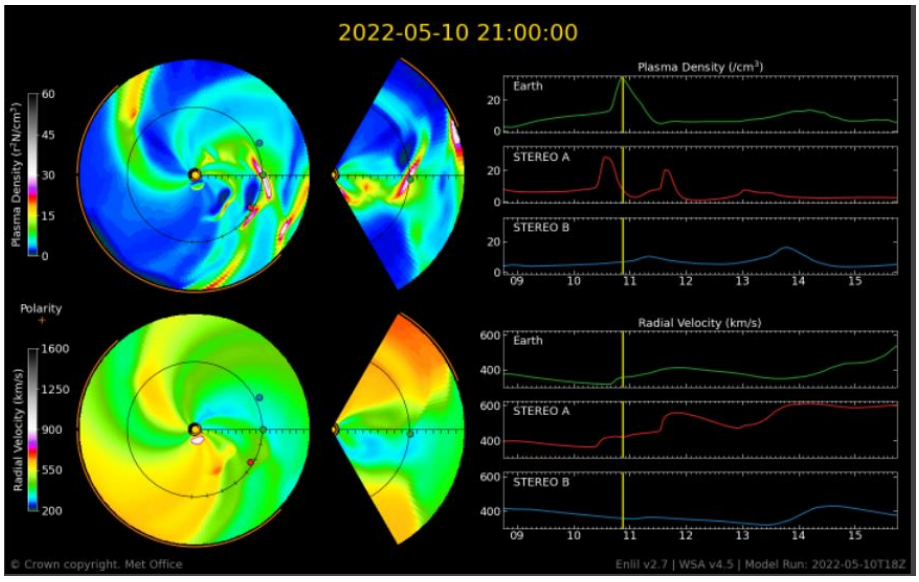
A CME which left the Sun on 06 May was expected to arrive at Earth on 10 May. There is suggestion in the data that this feature glanced the Earth, but a risk is maintained in case the main mass of the CME arrives at Earth on 11 May. A X1.5 flare on 10 May from south-centre disc appears to have produced a CME, which will be analysed when further data becomes available. Any CME from this location could have an Earth-directed component and arrive before the end of the forecast period.

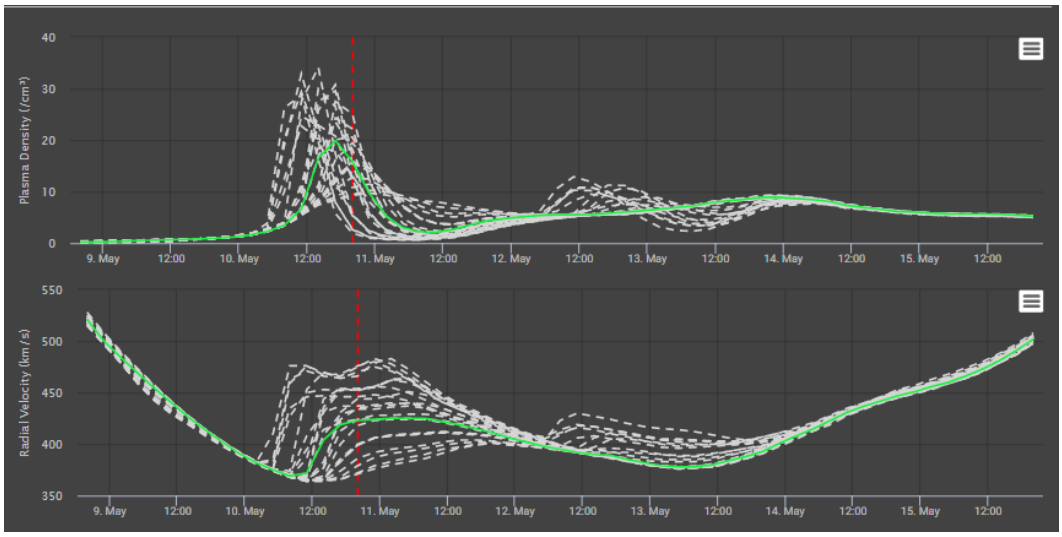
The high speed stream from coronal hole 80 was forecast to connect with the Earth on 10 May, but solar winds have remained relatively muted. Based on the relative positions of the Earth and the coronal hole, there is a chance that the earth may not experience the full high sped stream. STEREO A, which is at a similar latitude to Earth, did not experience any significant increase in speeds at the time when the coronal hole was likely to have passed the spacecraft.

Geomagnetic activity is expected to be mainly Quiet to Unsettled with a slight chance of G1 storms on 11 May due to any delayed arrival of the CME or high speed stream. A return to mainly Quiet conditions is then likely by the 12 May, although this will need to be reviewed in the light of any potential new CMEs from 10 May.

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	20	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: Enlil MOSWOC model showing most likely arrival time for potential CME. However uncertainty in potential arrival times is demonstrated by the MOSWOC ensemble forecast which forecasts a range of potential arrival times for small changes in starting conditions.





Radio Blackouts - X-Ray Flares:

AR3006 (Dai/βγδ) and AR3007 (Dsi/βγδ) both contain delta spots, although the one in AR3007 is becoming more tenuous. AR3006 has been the more active of the two regions, producing an X1.5 flare and a potentially Earth-directed CME. AR3007 has produced a C-class flare and a non-earth-directed CME. As both regions are likely to remain on the disc through the next four days the risk of Moderate or High activity is increased due to the recent history of the regions.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	40	40	40	40
Very Active	R3 to R5 X Class	No	15	15	15	15

Figure 3: GOES 16 X-ray flux

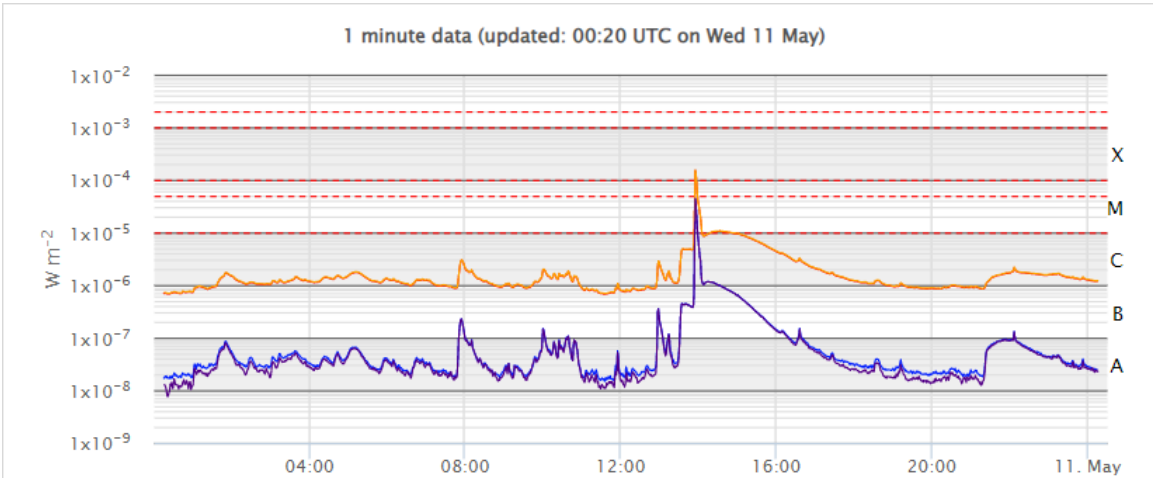


Figure 4: SDO imagery of the flare from AR3006.

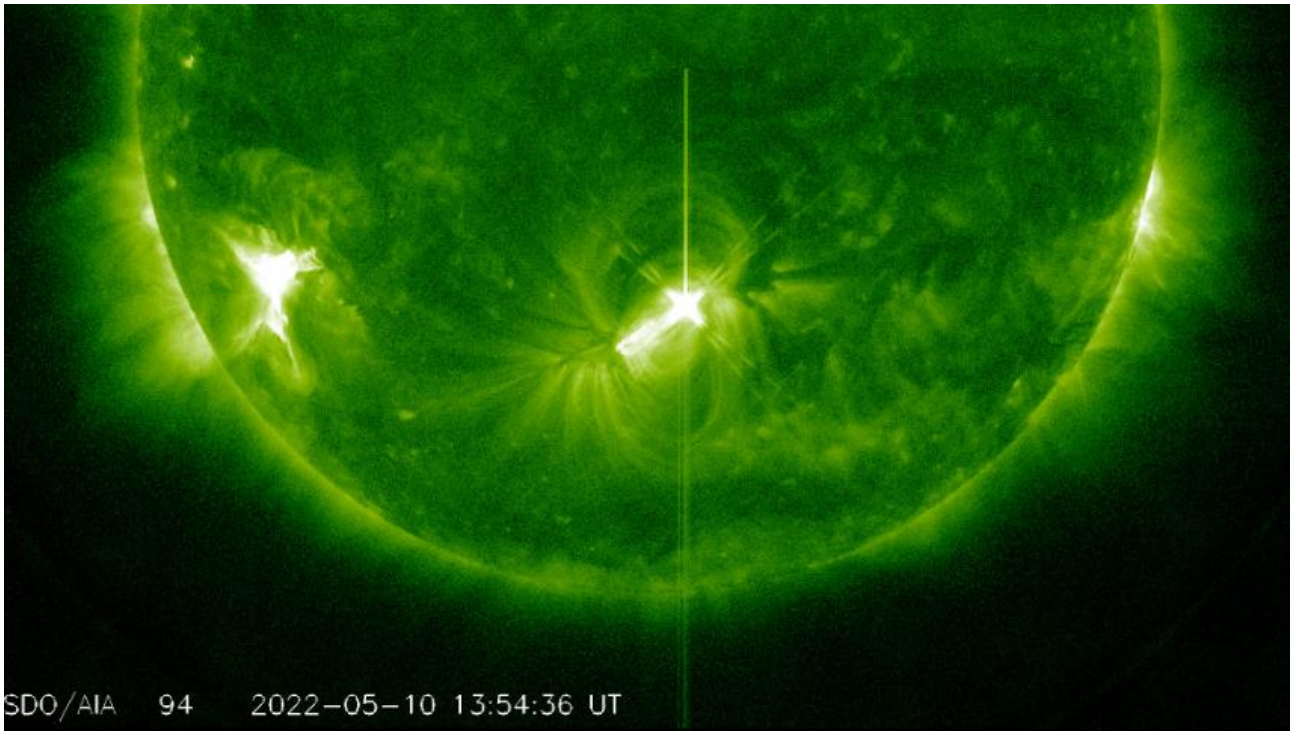
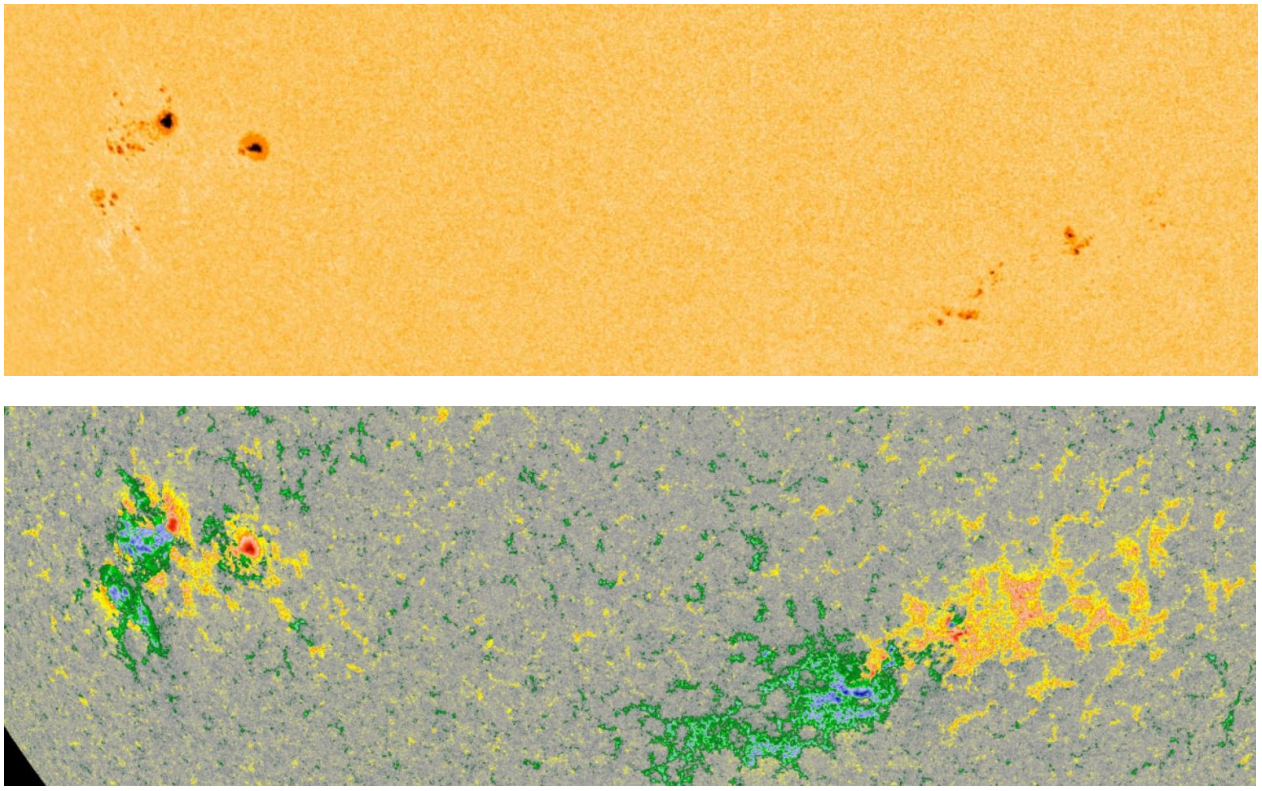


Figure 5: HMI intensitygram and magnetogram imagery for A3007 (left) and AR3006 (right).



Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as measured by GOES-16 at GEO is at background levels. There is an increasing risk of proton storms as AR3006, which produced an X1.5 flare on 10 May moves across the western hemisphere, where an solar radiation storms are more likely to be Earth-directed.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	10	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) is expected to be at mainly background levels through the forecast period with no significant solar winds expected. This is allowing for the possibility of coronal hole 80 high speed stream connection, although it is likely to be a weak feature, given the delay in arrival.

Electron fluence levels are well below the Active threshold and are not expected to increase significantly through the next four days.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1